

(12) **United States Patent**
Hiyoshi et al.

(10) **Patent No.:** **US 9,543,429 B2**
(45) **Date of Patent:** **Jan. 10, 2017**

(54) **SILICON CARBIDE SEMICONDUCTOR DEVICE**

(58) **Field of Classification Search**
CPC H01L 29/1608; H01L 29/66068
(Continued)

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(56) **References Cited**

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U.S. PATENT DOCUMENTS

5,169,793 A 12/1992 Okabe et al.
5,464,992 A 11/1995 Okabe et al.

(Continued)

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FOREIGN PATENT DOCUMENTS

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

JP H04-229661 A 8/1992
JP H07-249765 A 9/1995

(Continued)

(21) Appl. No.: **15/026,842**

OTHER PUBLICATIONS

(22) PCT Filed: **Aug. 11, 2014**

International Search Report in PCT International Application No. PCT/JP2014/071173, mailed Oct. 21, 2014.

(86) PCT No.: **PCT/JP2014/071173**

§ 371 (c)(1),

(2) Date: **Apr. 1, 2016**

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(87) PCT Pub. No.: **WO2015/049923**

PCT Pub. Date: **Apr. 9, 2015**

(57) **ABSTRACT**

There is provided a silicon carbide semiconductor device allowing for increased switching speed with a simpler configuration. A silicon carbide semiconductor device includes: a gate electrode provided on a gate insulating film; and a gate pad. The gate electrode includes a first comb-tooth shaped electrode portion extending from outside of the gate pad toward a circumferential edge portion of the gate pad and overlapping with the gate pad at the circumferential edge portion of the gate pad when viewed in a plan view. A p+ region includes: a central portion overlapping with the gate pad when viewed in the plan view; and a peripheral portion extending from the central portion toward the outside of the gate pad, the peripheral portion being provided to face the first comb-tooth shaped electrode portion of the gate electrode with a space interposed therebetween.

(65) **Prior Publication Data**

US 2016/0300943 A1 Oct. 13, 2016

(30) **Foreign Application Priority Data**

Oct. 4, 2013 (JP) 2013-209434

(51) **Int. Cl.**

H01L 29/15 (2006.01)

H01L 29/78 (2006.01)

(Continued)

(52) **U.S. Cl.**

CPC **H01L 29/7811** (2013.01); **H01L 29/0623** (2013.01); **H01L 29/1095** (2013.01); **H01L 29/1608** (2013.01); **H01L 29/402** (2013.01)

5 Claims, 15 Drawing Sheets

